DIABLO CANYON POWER PLANT SITE ECOLOGICAL STUDY

QUARTERLY REPORT NO. 5

by

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ABSTRACT

During the period July 1 - September 30, 1974, surveys for the Upwelling Period of the random intertidal and subtidal and permanent subtidal stations continued. A total of 11 random subtidal, 9 permanent subtidal and 8 random intertidal stations were sampled in the two study areas. In addition, 9 permanent subtidal stations were remarked with eye bolts, wire rope and new rope and surface buoys.

Several inspection dives were made in the Intake Cove Area behind the breakwaters to follow dredging progress. A limited biotic recovery on the periphery of the cove to a depth of 6 m (20 ft) appears to be occurring.

Pump operation was also followed closely during testing procedures and at least three problem areas associated with the discharge of cooling waters were found to exist.

Interviews of both sea urchin and abalone fishermen working the coastal waters near the plant site were conducted. Activity of urchin fishermen has been fluctuating due to varying gonadal conditions of the urchins.

Numbers of sea otters in the Point Buchon to Diablo Cove area have continued to diminish from the numbers observed in spring 1974. However, evidence of foraging, in the form of broken urchin tests, is very strong in Diablo Cove.

A new study to establish catch-per-unit-of-effort data of sport-fishes by angling was begun this quarter.

This is the fifth quarterly report submitted in partial fulfillment of Research Contract No. 6S-1047 between the Department of Fish and Game and the Pacific Gas and Electric Company. Through this contract, the Department of Fish and Game is to conduct ecological monitoring studies to determine what changes have occurred during 1970 and 1971 in the base line inventory of the marine biota, with special reference to fish and abalone.

Quarterly reports will be followed by annual reports. Full tables and species lists will be included in each annual report.

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INTRODUCTION

This fifth quarterly report covers Department of Fish and Game Ecological Studies at Diablo Canyon Power Plant Site during the period July 1 through September 30, 1974. During the quarter we continued to occupy random intertidal and subtidal stations as well as conduct summer surveys of the permanent subtidal stations. Commercial abalone and urchin fishermen were interviewed whenever possible for catch-per-unit-of-effort information and counts and feeding behavior of sea otters, *Enhydra lutris*, were monitored. In September we undertook a catch-per-unit-of-effort study of sportfishes in Diablo Cove and the North Control. These studies are designed to assess the impact of natural and man-made changes on Diablo Cove communities and natural changes in our North Control Area.

OPERATIONS

Random Subtidal Station Surveys

We surveyed 11 random stations during August and September; 8 in the North Control Area and 3 in Diablo Cove (Figure 1). During May and June we occupied 11 stations in Diablo Cove and 6 in the North Control Area.

The giant red sea urchin, *Strongylocentrotus franciscanus*, was the dominant macroinvertebrate in both areas. The mean count per 30 m^2 (327 ft^2) station during August and September in Diablo Cove was 27.0 and 65.0 in the North Control Area. The mean count per station of giant red sea urchins obtained at random stations during May and June was 114.9 and 31.3 in Diablo Cove and North Control Areas respectively. The wide difference in means is probably due in part to the number of stations and depths surveyed, although the decrease in Diablo Cove is probably due to extensive foraging by sea otters. The sea star, *Patiria*

miniata, was the second most abundant macroinvertebrate. Red abalone, *Haliotis rufescens*, were not observed at any of the three Diablo Cove stations, but in the North Control Area they were present at four of the eight stations surveyed with a mean per station of 1.8. It is unfortunate that we do not have baseline counts for this area before the sea otters began foraging in 1973.

Of the six species of brown algae quantified in Diablo Cove, bull kelp, *Nereocystis leutkeana*, with *Laminaria setchelii*, and *Pterygophora californica*, were the most abundant with station means of 78.0, 63.3 and 56.3 respectively. In fact, the bull kelp canopy in Diablo Cove appears to be much larger than in 1973. Counts of the same three species of brown algae in the North Control yielded lower means, 1.5, 7.8, and 10.0 respectively.

Permanent Subtidal Station Surveys

Most of our time in July was devoted to locating and remarking the permanent subtidal stations. Four of the stations were located and marked with new buoys (Stations 6, 7, 11, 15). However, we were unable to locate stations 8, 9, 10, 12 and 16. We therefore reestablished these stations in the same general areas of the old stations. Unfortunately, we will not be able to make long term comparisons on these new stations except in terms of average counts per station. In addition, we installed permanent eyebolts at each end and in the middle of every station to aid in locating stations with missing surface buoys and to increase standardization. These eyebolts are connected by wire rope along the length of the transect. We also took bearings on three landmarks at each station to aid in relocation. We have abandoned Burge and Schultz's stations 13 and 14.

In August we surveyed nine stations. Giant red sea urchin numbers continued to decline at some stations. Mean counts at stations 6, 7, 11 and 15 reported by Burge and Schultz in 1971 were 260, 275, 84 and 252 respectively. Our August survey yielded 78, 75, 84 and 384 urchins respectively at these stations. The average count of giant red sea urchins at all nine of the stations surveyed in August was 121.3; this compares with an average of 193.6 urchins per station in 1971. Red abalone numbers also decreased. Our average count at the nine stations surveyed in August was 1.4. In 1971 the average for these nine stations was 8.4.

Counts of *Nereocystis leutkeana* stipes at the nine subtidal stations surveyed in August increased markedly from last year. In September 1973 the average count at eight stations was 3.1 stipes, in 1974 the average was 46.9 stipes.

Random Intertidal Station Surveys

During this quarter, eight random intertidal stations were sampled; four in the North Control Intertidal Area and four in the Diablo Cove Study Area (Figure 1). Methods used to sample invertebrates and algae were consistent with previous surveys and additional counts of abalone were made along a line 1 m (3.3 ft) to either side of the 30 m (99 ft) transect line. In the laboratory, work continued in processing the 'soft' algae samples from the Upwelling Period (March through August) to obtain biomass figures.

Since so few samples were taken after July 1, the data have not been quantified here but will appear in the next Annual Report when they will be treated with the rest of the Upwelling Period sampling data. In general, however, invertebrate numbers and composition appear to be unchanged since the last Quarterly Report, but amounts of algae processed to date from the ¼ m^2 (2.7 ft^2) samples taken in June and July have

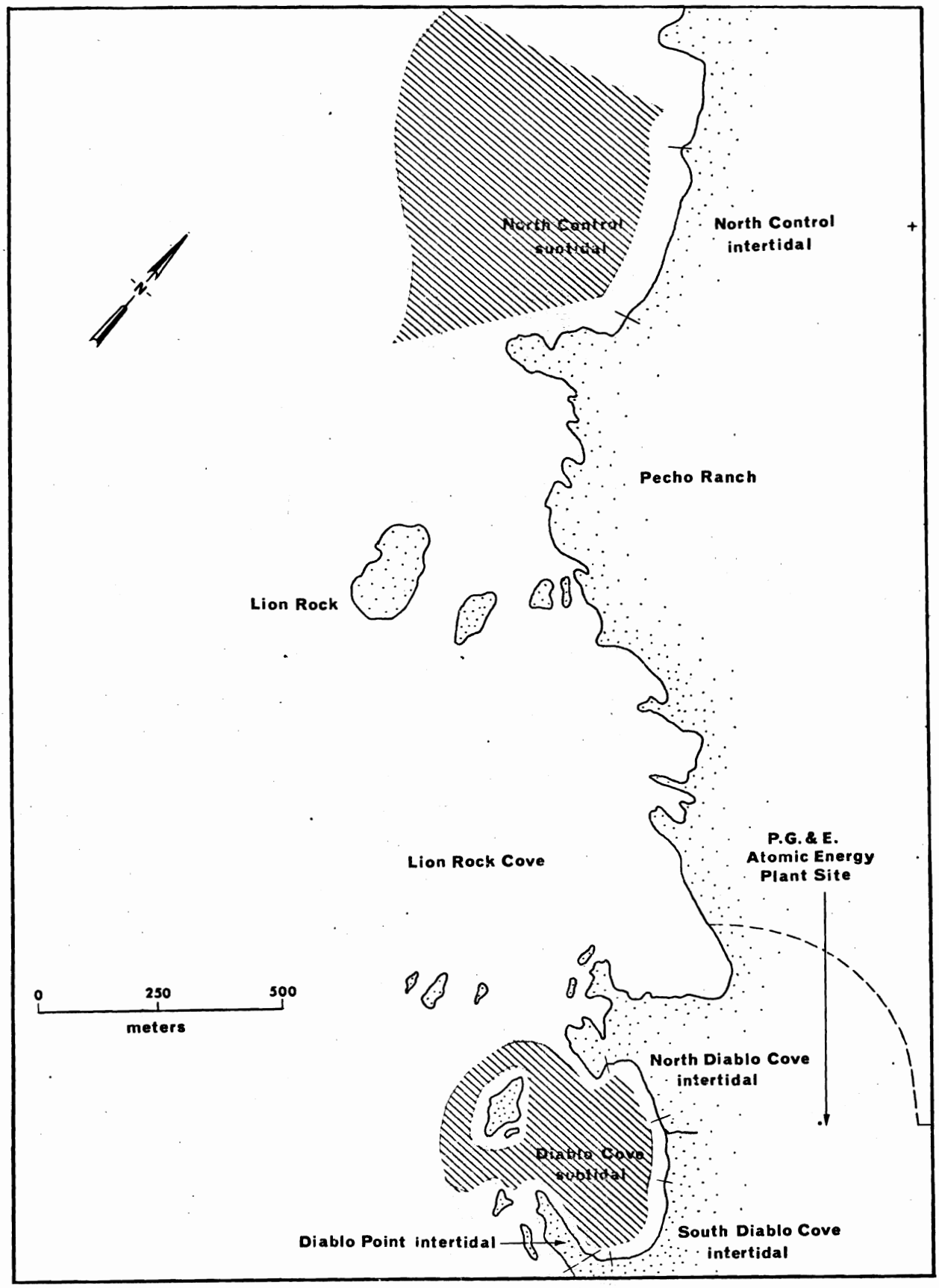

FIGURE 1. Location of Random Subtidal and Intertidal Areas - Diablo Canyon Power Plant Site.

increased substantially, probably in response to summer upwelling conditions.

Numbers of red and black, *Haliotis cracherodii*, abalone counted along the transect line at the stations in July and August appear to be diminished in the North Control Intertidal and the North Diablo Cove Intertidal, both areas of recent otter habitation. Whether these lower numbers are artifacts of a low number of samples will be determined with future surveys.

Intake Cove

Several diving surveys were conducted within the Intake Cove since July 1, 1974, to inspect dredging progress and to briefly assess the biota. Dredging operations, restricted to the area between the breakwater and intake structure, are still in progress. Approximately one quarter of this area remained to be dredged at our last inspection dive in September.

A limited recovery of the biological community within the cove has occurred. Folliose red algae are developing along the breakwater. Species noted include *Gigartina californica*, *Ptilota densa*, *Weeksia reticulata*, *Callophyllis* sp. Several of these red algae and *Ulva* sp. were observed extending down to a depth of twenty feet. The associated invertebrate community has also diversified beyond the detrital feeders seen in earlier surveys. New groups include pandalid shrimp, hydroids, bryozoans, several nudibranchs (*Hermissenda crassicornis*, *Acanthodoris brunnea*, and *Dendrodoris fulva*) and ascidians (*Styela* sp. and *Ciona* sp.). Stands of giant kelp, *Macrocystis pyrifera* and *Nereocystis leutkeana*, were evident and in good condition.

Fish populations are now composed of most common forms found in nearshore waters surrounding the cove. Demersal fish included painted greenling, *Oxylebius pictus*, blackeye gobies, *Coryphopterus nicholsii*,

lingcod, *Ophiodon elongatus*, cabezon, *Scorpaenichthys marmoratus*, and round stingrays, *Urolophus halleri*. Other species observed were blue, *Sebastes mystinus*, black, *S. melanops*, and copper, *S. caurinus*, rockfish; shiner, *Cymatogaster aggregatta*, rainbow, *Hypsurus caryi*, and pile perch, *Damalichthys vacca*; and bocaccio, *Sebastes paucispinis*.

Quantification of red algae, selected invertebrates, and brown algae is planned using our subtidal random sampling method. This survey will be initiated during the next quarter.

Pump Operation

Three problem areas directly related to pump operation which will affect the biological communities became evident during and after pump testing. These areas are turbulence, foam, and high levels of copper ions in discharge waters.

Discharge of water through the outfall structure produces a turbulent, highly oxygenated layer of surface water which extends several hundred meters into Diablo Cove. This turbulence reduces light penetration immediately under the affected area and produces a surface foam. In addition to being aesthetically unpleasant, this surface foam appears very stable and capable of reducing light penetration in areas not directly influenced by turbulence. Reduced light would almost certainly have a deleterious effect on benthic algae, especially on developing sporophytes of *Nereocystis leutkeana* in spring. Distribution of foam and turbulence will vary with wind and current and together are capable of affecting all portions of the cove.

Copper ion accumulation in discharge waters became apparent after the Department of Fish and Game investigated an abalone die-off in Diablo Cove. The Morro Bay Management Unit and Environmental Services Branch conducted

on-site surveys, bioassays, and water and tissue testing. After this investigation, the die-off was attributed to high copper ion concentrations. Pauses in pump testing are apparently responsible for the accumulation of copper ions within the plant's cooling water system conduits.

Sea Urchin Fishery

The intensity of the commercial sea urchin harvest fluctuated widely, primarily due to changing demand due to condition of the gonads. Most of the urchins are being harvested from a small area near Pecho Rock, however, divers have also been working off Shell Beach. We conducted 44 interviews of divers between July 1 and September 30 and the average catch-per-hour was 361.2 kg (795.5 lb) for this period. This compares to an average catch-per-hour of 234 kg (515 lb) from July 1973 through June 1974.

Abalone Fishery

Commercial abalone diving effort increased during the quarter as sea urchin fishermen entered the fishery because of poor urchin market demand. A total of eight divers was interviewed. Their catch consisted of 443 red abalone, for a catch-per-hour of 7.6 abalone. Most of the effort centered around Pecho Rock. A few divers have been observed just south of Diablo Cove.

Sea Otter Counts

Sea otters continued their movements southward. Last year at this time, the herd was located about 0.5 nautical mile north of Lion Rock. During this quarter, most of the rafting animals have been observed in the cove east of Lion Rock (North Cove). The size of this herd continues to decrease; in July the average count was 53, in August 41, and 39 animals in September. Feeding activity has been observed both in North

Cove as well as Diablo Cove, but the animals seemed to avoid Diablo Cove when the pumps were operating. Divers have observed large quantities of empty urchin shells from otter foraging in Diablo Cove and North Cove. Of eleven otters observed feeding, four each were feeding on abalone and sea urchins.

Catch-Per-Unit-of-Effort of Sportfishes Study

In September we initiated a study of catch-per-unit-of-effort of sportfishes in Diablo Cove and the North Control Area. This study is designed to yield sport catch data not readily available from existing hook and line sportfisheries, such as species composition and size composition, catch-per-hole-per-hour for each species and possible relationship of catch-effort with changes in water clarity and temperature.

The sampling design is as follows: At each subtidal station, fishing takes place for 30 min, utilizing standard fishing rods and reels with terminal tackle consisting of 4-hook "Wonder Jigs." The number of rods used at each station depends upon the number of fishermen available. The jigs are fished either with or without bait (usually squid). The objective of a study is to catch as many fish as possible, regardless of species. A secchi disc reading and surface and bottom temperature is recorded at each station. Data recorded for each fish includes species, total length and sex (if discernible). If the fish is badly injured it is retained, otherwise, all fishes are returned alive to the water. A few fish of selected species will also be retained during the study for stomach analysis and other life history studies.

During September we completed six fishing stations in the North Control Area and two in Diablo Cove. The North Control yielded a total of 39 fish for an average catch of 10.4 fish-per-pole-hour. The 36 blue rockfish, *Sebastes mystinus*, made up the lion's share of the catch. The

catch also included two gopher rockfish, *S. carnatus* and one black and yellow rockfish, *S. chrysomelas*.

The two stations in Diablo Cove did not produce a single fish; this was due, in part, to the dense bull kelp canopy which made fishing very difficult.

MAN-DAYS SPENT AT DIABLO CANYON POWER PLANT SITE

July 1 - September 30, 1974

Intertidal Surveys:	July 1 - 2
Participants:	Laurent, Wendell and Farrens
	August 16 - 20
Participants:	Wendell and Farrens
Subtidal Surveys:	July 22 - 26
Participants:	Gotshall, Wendell and Farrens
	August 4 - 9
Participants:	Gotshall, Wendell and Farrens
	September 17 - 21
Participants:	Gotshall and Laurent
Commercial Abalone & Sea Urchin Fishing Surveys:	
	August 15, 16, 23, 26
	September 5, 10, 11, 15, 23, 25, 26, 27
Participants:	Benech
Boat maintenance	July 17 - 21
Participants:	Farrens

Total man-days during quarter:	249
Total man-days at site:	58
Boat-days lost to weather:	0
Total stations surveyed:	36

Travel time man-days	13
Boat time (hr)	25
Laboratory time man-days	204

PROJECT PERSONNEL:

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